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ABSTRACT

Punting characteristics of a subject were studied over an 8-year period. Performances were recorded from the age of 2 years 9 months through 11 years 4 months. Fifteen film records were made at 3-month intervals through ages 3 and 4, at 6-month intervals through ages 6 and 7, and at 1-year intervals through ages 8 to 11. Movement characteristics studied included the steps in the approach to the kick, the release of the ball, arm and leg action, trunk action, timing relationships between segment actions, angular velocities of the thigh and knee, and variability of the traits at various age levels. Four levels of development were tentatively identified on the basis of the observed changes in movement characteristics. (Author/JB)

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DEVELOPMENTAL CHANGES IN THE MOVEMENT CHARACTERISTICS OF THE PUNT--A CASE STUDY*

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The purpose of this study was to determine the changes in movement characteristics in the punt of a young boy between the ages of two years, nine months and eleven years, four months. The data analyzed in this study was from a longitudinal research project entitled "Ontogenetic Development in Selected Motor Tasks" conducted by Dr. Lolas Halverson in the Motor Development and Child Study Center at the University of Wisconsin, Madison. This paper is an extension of a preliminary report made to the research section by Halverson and Roberton in 1966. (Halverson and Roberton, 1966) Records were made at three month intervals at ages three and four years; six month intervals at ages five through seven years; and at yearly intervals at ages eight through eleven years. In all, fifteen separate age levels were studied.

At early ages, the child was asked to kick a large plastic ball out of his hands. By age seven, the child used a heavier ball (either a volleyball or soccer ball), recognized the task by name, and was able to perform the punt when asked.

Front and side views were taken of different trials with a 16 mm camera operating at 64 frames per second in all but the final filming session. The data for that filming session at eleven years, four months of age was obtained in a three-way filming situation in which simultaneous front, side, and back views were filmed.

Because of the amount of time required to do an in-depth analysis of filmed data, one trial was analyzed at each age level; the trial was selected on the basis of the completeness of the film record and the inclusion of a side view for measurement purposes. Tracings were made on a P-40 Recordak of key individual frames throughout the punt including the frames representing ball release from the hands, placement of the supporting foot on the floor, contact of the ball with the foot, and at least five frames preceding ball contact. Segment lines for the trunk and lower extremities were placed on a line of best fit through the segments so that measures of trunk inclination and knee extension could be made. An average velocity for knee extension was calculated by dividing the degree of change in knee angle by the time in which the change occurred.

Movement characteristics which were verbally described included:

1) approach to the kick;
2) height and manner of ball release;
3) time elapse between ball release and supporting foot contact;
4) arm action throughout the kick;
5) height at which the ball was contacted.

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Observed changes in the movement characteristics in this subject over an eight year period included:

1. There was an increase in the length of stride and number of steps in the approach to the kick. In early attempts at 2 and 3 years of age, HR started with his feet together, took one short, wide step with the left (supporting) foot and swung into the ball with the right foot. By ages 3½ and 4, the approach step was longer and narrower. This one step approach was consistent until about six years of age.

   A two step approach to the kick was observed at six years, seven months of age. The subject took a preliminary step forward on the right (kicking) foot, then a step with the left foot, and swung the right foot into the ball. The two step approach changed with an increase in the length of each step at later ages.

   Finally, a brief period in which the body was completely off the ground--a flight phase--was incorporated into the second step of the two step approach at ages nine through eleven.

2. The height and manner of the ball release varied at different ages. The earliest punt attempts were marked by a shoulder high drop release of the ball. HR continued to drop the ball by moving the hands laterally away from the sides of the ball until about age six, but the height decreased to waist level.

   After age six, a lift was imparted to the ball as a result of the hand holding the ball moving forward and upward on release.

3. The time of release prior to contact of the supporting foot with the floor increased through age eight from 30 milliseconds to 390 milliseconds. Ball release was slightly closer to contact of the support foot at ages nine through eleven years (220 to 340 milliseconds).

4. The height at which the ball was contacted decreased with age. Before age five, the ball was most frequently contacted above the level of the knee of the supporting leg. In later trials, the contact point was usually closer to the ground and most often below knee level.

5. Arm action in the punt showed definite changes with age. At the earliest ages, both arms dropped rapidly to the sides following ball release. By four years of age, opposition of the left arm with the kicking leg was evident at contact. Opposition remained a consistent trait throughout the age span.

6. Angular velocity of the kicking knee at contact increased with age through age eight years and then appeared to level-off through age eleven. The changes in knee velocity were:

2-3 years	500-700°/ second
3-5 years	1000-1500°/ second
5½-7½ years	1800-2000°/ second
8½-11½ years	1680-1730°/ second

These figures should be considered as quite tentative because of the difficulty of keeping children in camera plane and because of the slow camera speed. However, the velocities from age five years on compare favorably with knee extension velocities in the soccer kick of a mature male (1500-2000°/ second) as reported by Roberts and Metcalfe (1967).

On the basis of the observed changes over the eight year period, four tentative stages of development in the subject's punt were identified. Since changes in approach were most dramatic, these provided the criterion for initial identification of stages. Changes in additional traits appeared in conjunction with the changes in approach and aided in describing the stage more fully. The identified stages were described as:

Stage 1: The approach to the kick was one short, wide step with the support foot; the ball release was immediately before the contact of the support foot with the floor and was the result of a drop from shoulder level. The support leg was extended throughout the kick; the trunk and head were flexed slightly forward of the vertical. Ball contact was above supporting knee level with flexion of the kicking knee evident. Balance was precarious as the child tended to fall off balance toward the kicking side.

Ages 2-3

Stage 2: The approach to the kick was one long, narrow step with the support leg; the ball was dropped from mid-chest level. The support leg flexed at the knee as the kicking leg began to swing forward and contact was at the level of the support knee. The trunk was inclined back of the vertical with the head flexed forward at contact. Opposition of the left arm and right leg was evident at contact and the knee of the kicking leg was near complete extension (150°). Balance was maintained by stepping backward as the kicking leg returned from the follow-through.

Ages 4-6

Stage 3: The approach began with a step forward on the right (kicking) foot followed by a second step on the left (supporting) foot; ball release occurred prior to the beginning of the second step. The ball was lifted upward and forward on release from a position slightly above waist level. The support knee was flexed and contact was below support knee level. Trunk lean backward was slight and opposition of the left arm and right leg was present although both arms were flexed and held close to the body. Follow-through of the kicking leg was limited and below waist level.

Ages 6½-8

Stage 4: The two step approach increased in length of stride and a brief (3-4 millisecond) period of flight preceded placement of the support foot on the floor. The second step provided, in effect, a run or leap into the kick. Release occurred slightly after the support foot left the ground for the second step; the ball was lifted upward and outward from chest level. The support knee was flexed slightly at contact and the body weight was held on the toe of the support foot. Contact was below the level of the knee of the support leg. The trunk and head were flexed forward at contact and opposition was evident. There was greater extension of the arms and legs and higher follow-through of the kicking leg.

Ages 8½-11½

In summary, the major changes across stages in the subject's punt development over eight years included:

1. a change from a one step approach to a two step approach in the kick with a period of flight occurring in the second step of the approach in the most advanced stage;

2. a change from dropping the ball from a height between waist and shoulder level to a lift release which projected the ball upward and outward from the body at chest level;

3. increasing use of opposition of arm and leg to improve stability following ball contact in the kick.

In addition to the changes related specifically to the stages of punt development, it was noted that the velocity of knee extension progressively increased until it reached a level comparable to adult velocity. The combined effects of these changes resulted in a smoother, more forceful punt at the last age level studied.

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